Chapter 4
Station Design

4-1. Station Capacity

Pumping station capacity requirements are normally determined by the hydraulics engineer in accordance with EM 1110-2-1413. This manual provides the basis for establishing pumping requirements for the maximum and minimum river stages, and the maximum water stages permissible in the protected area. The latter will be referred to the station location and will establish the maximum allowable water surface elevation in the station sump. The hydraulic data provides the basic information needed for the selection of equipment and, in turn, the layout of the station. In those special instances where an increase in pumping capacity can be definitely expected at some future date, consideration should be given to a station design which facilitates the installation of increased capacity in a manner that will give the greatest overall economy. Alternate studies of pumping stations satisfying the required pumping capacity should be made for all pumping station projects. As a minimum, the studies should include station location, station site layout, all equipment, sizing of pumps, type of operation, and operating and maintenance costs and first costs.

4-2. Station Location

a. General. Experience has shown that a pumping station should be located or sited in such a manner to produce the most direct inflow possible. Any location that produces asymmetrical flow into the pump bays causes problems with circulation, uneven velocity distribution, vortices, and generally poor pump performance. This is true for inflow confined within an inlet channel, sewer, or a large ponding area. Additional engineering studies and/or physical modeling may be required when circumstances exist that prevent recommended station siting. Gravity flow structures, when provided, can be located in an offset position without additional cost and still perform adequately.

b. Line of protection. The location of stations with respect to the line of protection should be selected for safe operation. Construction of the station integral with a concrete floodwall will, in general, minimize the hazard of discharge line failure. On projects with an earth levee or where right-of-way restrictions exist, the station may be located at the landside toe of the levee. More hazardous locations (riverside of protective works) may be considered if a definite operational or economic advantage is presented. Vehicle access to stations at all flood elevations should be carefully considered in station location, and minimum but adequate provision should be made to permit safe operation of service vehicles bringing in equipment during construction and operation and maintenance.

c. Operating floor elevation. The operating floor elevation should reduce the possibility of damage, caused by flooding, to the pumping equipment. This elevation is dependent upon the hydraulics and hydrology criteria, the location, and the physical layout of the pumping station.

(1) When the pumping station is located on the line of protection, the elevation of the operating floor will depend on whether the pumping station is subject to the discharge pool elevations, or is protected by a flood wall or a discharge chamber. When the pumping station is subject to the discharge pool elevations, the operating floor should be no lower than the top of the levee. When the pumping station is protected by a flood wall or a discharge chamber, the operating floor elevation should be located at least 0.3 m (1 ft) above the interior level of design protection.

(2) When the pumping station is not located on the line of protection, the elevation of the operating floor should be at least 0.3 m (1 ft) above the interior level of design protection.

(3) For high, nonpumping water levels, one method to reduce the operating floor elevation is to floodproof the facility. Floodproofing would be achieved by providing watertight doors or bulkheads at all openings. If floodproofing is being considered, the cost and practicality to floodproof the facility should be carefully studied.

4-3. Station Type

a. Floodwater pumping stations. These stations should be of the wet-pit (sump) type employing vertical mixed-flow or axial-flow pumps in practically all cases. These pumping units may also be of the submersible type (Plate 1). Floodwater pumping stations usually pump directly from open storage ponds, ditches, or stormwater sewers. When practical, provision should be made for exclusion of water from the pump sump and for maintaining the sump in a dry condition during inoperative periods. A typical station for pumping water from an extensive open ponding area is shown in Plates 2 and 3. This station is located at the edge of the ponding area, adjacent to the gravity drainage structure discharging through the levee. The station's inlet sump is at an

elevation considerably lower than the gravity flow stream requiring the sump to be pumped dry when the station is not in use. A large pumping station that pumps from an open sump is shown in Plates 4 and 5. A typical stormwater pumping station that pumps from a stormwater sewer is shown in Plates 6 and 7. Occasionally stations will be located over streams or drainage canals and in such instances pumps must be protected from damage by runoff during inoperative periods. Since the liquids pumped by stormwater pumping stations are generally not of a particularly corrosive nature, a wider latitude in selection of materials is permitted.

b. Combination flow pumping stations. Stations in which flows consist of some combination of stormwater and domestic and industrial wastes are characterized by having to pump runoff containing undiluted waste. The possibility of fumes and vapors should be considered when designing the sump ventilation system and electrical features located in the sump. When wastes are combined with stormwater, the need for a smaller pump to handle dry weather flows and runoff from light rains should be provided. This baseflow pump should be a submersible, nonclog pump. The baseflow pump is located in the main sump and equipped so that it can be raised for cleaning or repair, reducing the need for personnel to enter the sump. For stations on sewers having a relatively short time of concentration, it is necessary to place the stormwater pumps in operation within a short time after the start of rainfall. If large sluice gates are used to close the opening between forebay and the main sump, power operation of the gates will be required. Diluted domestic and industrial wastes will be present in the main sump. Protection against corrosive fumes and vapors is a greater problem than in stations handling only stormwater. All sump openings in the superstructure should be sealed airtight.